Controlled Slicing for Space Closure in Cases with Congenitally Missing Second Premolars

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The second premolars have the second highest incidence of congenital absence after the third molars.[1-6] The main challenge involved in treating this condition is to choose a treatment plan that will yield the best long-term outcome.

KRAVITZ KEYS

- First, the distal crown of the second deciduous molar was sliced using a high-speed bur, allowing mesial drift of the first permanent molar.
- After about 10 weeks, the tooth was hemisected to remove the distal half of the crown and root.
- The pulp was removed, and calcium hydroxide was injected to seal off the tooth.
- After about six months, the mesial crown and root were extracted.

The timing of the diagnosis is critical; in fact, there is strong evidence to suggest that such cases may go undiagnosed until age 9 or 10, or even later.[7,8] Congenital absence can easily be confirmed by radiographic evidence, including involution of the corticated border, with bone infill, and the absence of cusp-tip calcification.[9]

Treatment options for managing aplasia of a permanent second premolar include autotransplantation, orthodontic space closure, prosthetic replacement, and retention of the second deciduous molar.[10] Autotransplantation could be the treatment of choice in patients with uncrowded lower arches, deep bites, or hypodivergent mandibles. This method helps to preserve the buccolingual volume of the alveolar bone, while allowing the extraction space to be filled with a natural alternative. The upper third molar, because of its dimensional similarities with the lower second deciduous molar, makes a good candidate for autotransplantation.

Baccetti found strong correlations between second-premolar aplasia and several dental anomalies, including peg-shaped lateral incisors, enamel hypoplasia, ectopic eruption of the first molars and upper canines, presence of supernumerary


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teeth, and infra-occlusion of the second deciduous molars.[11] If the agenesis is accompanied by positional anomalies, orthodontic space closure may be the best option. Extraction of the second deciduous molar has been recommended to facilitate mesial migration of the first permanent molar,[12] with one study reporting that 80% of the extraction space closed spontaneously, leaving roughly 2mm of space distal to the first premolar.[13] Radiographic analysis has suggested, however, that most of this spontaneous migration occurs through mesial tipping of the first molar and distal tipping of the first premolar into the extraction space, leaving the occlusion in a compromised condition.[14] If the deciduous molar is extracted after root development of the first premolar and second molar, the chances of tipping are even greater, often resulting in a significant midline shift toward the side of the extraction.[15]

A number of factors need to be considered in treatment planning; for example, space closure following extraction of a deciduous molar may not be a good choice in low-angle patients or in those with deep bites and relatively level mandibular arches. Lingually tipped lower incisors or generalized spacing in the mandibular arch may complicate the mechanics involved in protraction of the first molars, since anchorage is critical in such cases. There is also a risk of flattening the patient's profile even further.

Considerations for prosthetic replacement of the missing premolar include the dental and skeletal relationships, the patient's dental stage, and the willingness of the patient to undergo extensive and expensive dental treatment. If the space is left open for eventual restoration, the objective is to leave the alveolar ridge in an ideal condition for implant placement once alveolar growth has basically ceased—after age 20 in women and even later in men. Unfortunately, Ostler and Kokich found a 25% decline in ridge width within three years of deciduous-tooth extractions.[16] Therefore, early removal of the deciduous teeth might necessitate bone grafting before implant placement.

In many situations, it might be preferable to leave the second deciduous molars in place. The potential disadvantage is that this may compromise the occlusion by creating a Bolton tooth-size discrepancy, due to the dimensional differences between the second deciduous molar and the second premolar.[2] In addition, Bjerklin and Bennet showed that a second deciduous molar tends to

ankylose over time, resulting in an infra-occlusion that can alter the occlusion because of supraeruption of the antagonists and mesial inclination of the adjacent permanent molar.[17] On the other hand, Sletten contended that the second deciduous molars could be retained for many years in adults who present with healthy deciduous molars.[18] Although infra-occlusion and root resorption have been found to occur independently with aging, no correlation with retained deciduous molars has been observed.[19]

Controlled-Slicing Technique

In 2004, Valencia and colleagues described a simple method called hemisection or controlled slicing.[5] This is a carefully planned and monitored technique that begins with slicing of the second deciduous molar's distal half, which promotes mesial drift of the first permanent molar. When the mesial movement can proceed no farther, the mesial half of the deciduous molar is removed. Careful calibration can avoid mesial tipping and an unwanted midline shift during spontaneous molar protraction, while the remnant of the mesial portion helps to maintain the alveolar width.[2]

After infiltration of local anesthesia, a high-speed instrument with an appropriate bur is used to slice the deciduous molar through its entire length to the undersurface of the crown. An initial slice of about 2mm on the distal aspect will serve to start mesial migration of the first permanent molar (Fig. 1). When the teeth have approximated, the entire distal half of the deciduous molar can be removed. Once the distal portion has been extracted, the pulp tissue is extirpated from the remaining mesial portion. There is no need to perform endodontic extirpation of the remaining mesial root; the mesial portion usually heals without negative consequences. The pulp chamber can then be sealed with calcium hydroxide paste to avoid contamination.

The remaining mesial section of the deciduous molar can be removed, if not already resorbed, when the first molar has migrated close to it. The mesial portion of the molar only rarely moves into

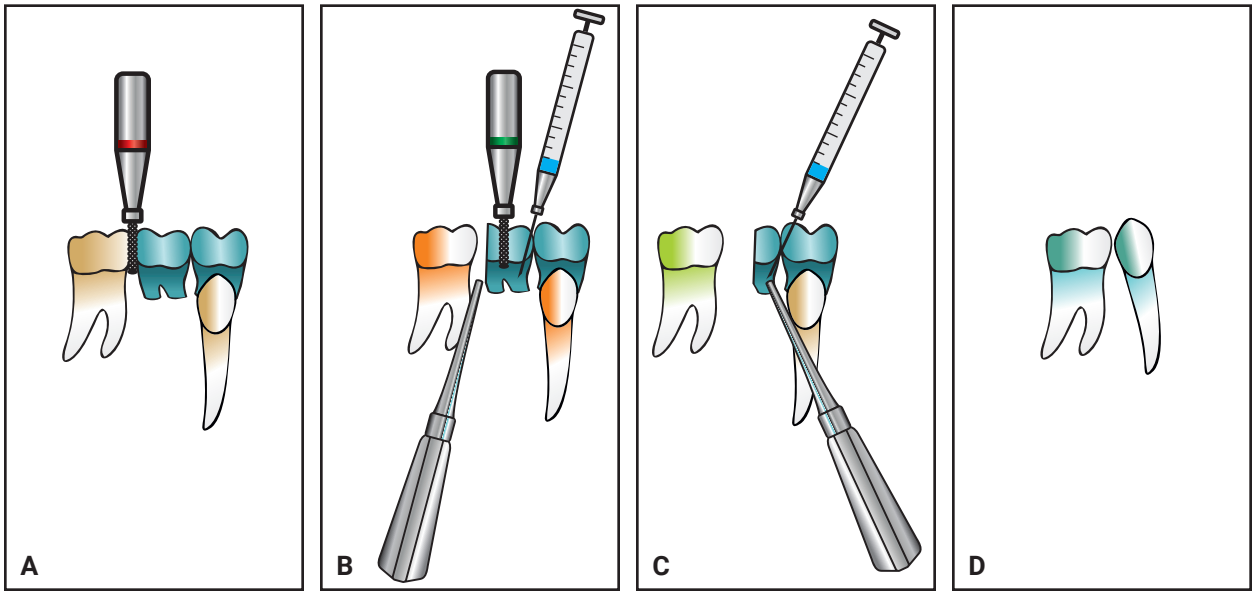

Fig. 1 Controlled-slicing technique for mesialization of lower first permanent molar into space of second deciduous molar. A. Initial slice of about 2mm made on distal aspect of deciduous molar to initiate mesial drift of first molar. B. Distal half of deciduous molar hemisected to promote further mesial drift. C. Mesial half of deciduous molar extracted for completion of mesial drift. D. Completed mesial drift and space closure.

the space previously occupied by the distal half. Once the mesial half is removed, however, the space will tend to close reciprocally, with distal tipping of the anterior segment. It is therefore important to reinforce anterior anchorage through the use of mechanics that will facilitate further mesial movement of the first molar.[20]

The following three cases demonstrate this therapeutic strategy.

Case 1

A 9-year-old female presented with Class I molar and canine relationships and congenitally missing lower second premolars (Fig. 2). The patient exhibited suboptimal oral hygiene and a carious lesion on the lower right second deciduous molar. Her parents had declined comprehensive orthodontic treatment despite repeated recommendations.

Autotransplantation was not considered because the patient was too young, and the third molars were not yet formed. Dental implants were not an option because the patient was still growing. Based on a poor long-term prognosis for the deciduous molars—due to the expected inadequacy of oral hygiene, the carious lesion on the lower right second deciduous molar, and the parents' reservations about comprehensive orthodontic treatment—we decided to use the controlled-slicing technique, even though it would normally be contraindicated by such a malocclusion.

Treatment began with partial slicing of the second deciduous molars' distal crowns, using a high-speed bur, to initiate mesial drift of the first permanent molars (Fig. 3). About 10 weeks later, the entire distal halves of the crowns and roots were hemisected and removed (Fig. 4A). The pulp was extirpated from the chamber of the mesial portion, and calcium hydroxide was injected to prevent contamination. It took about six months for the first molars to approximate the mesial halves of the second deciduous molars (Fig. 4B).

The mesial crowns and roots of the deciduous molars were then extracted (Fig. 5A). Further mesial drift of the first permanent molars into the remaining spaces lasted another nine months (Fig. 5B).

After an overall treatment time of 15 months, a bilateral Class III molar relationship was achieved

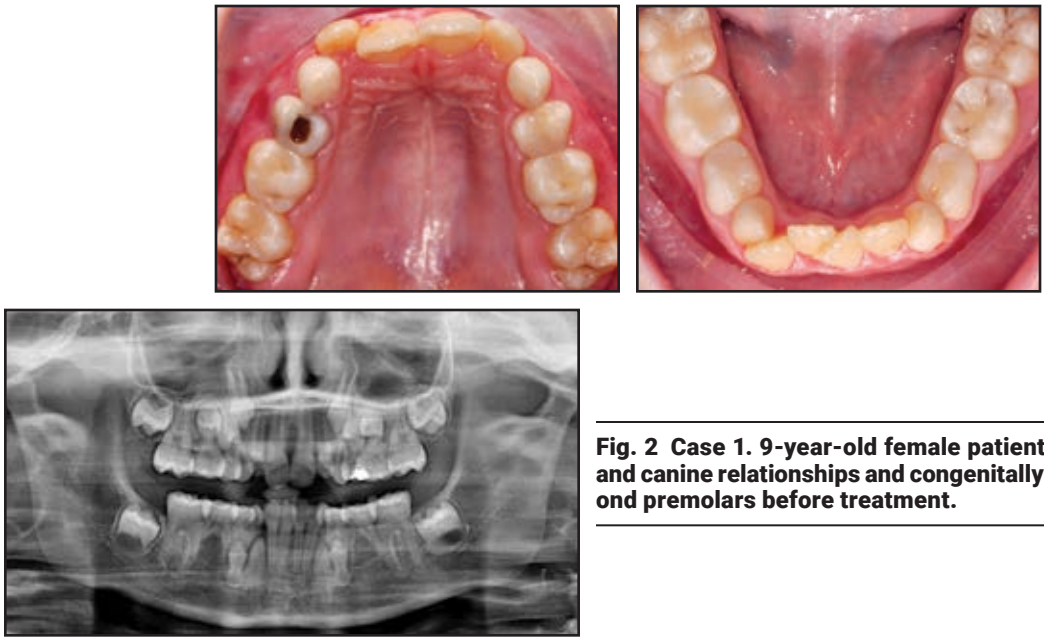

Fig. 2 Case 1. 9-year-old female patient with Class I molar and canine relationships and congenitally missing lower second premolars before treatment.

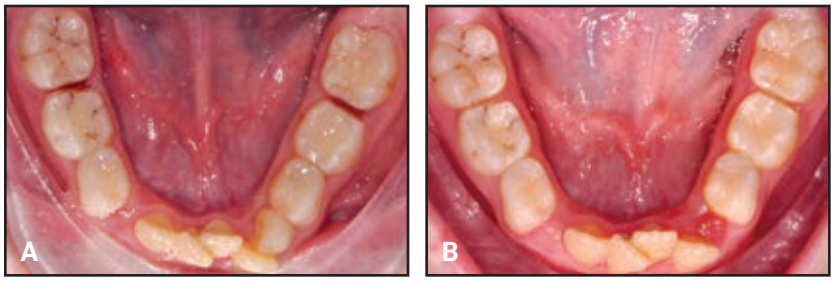

Fig. 3 Case 1. A. Distal aspects of lower second deciduous molars sliced to initiate mesial drift of first permanent molars. B. After 10 weeks of mesial drift.

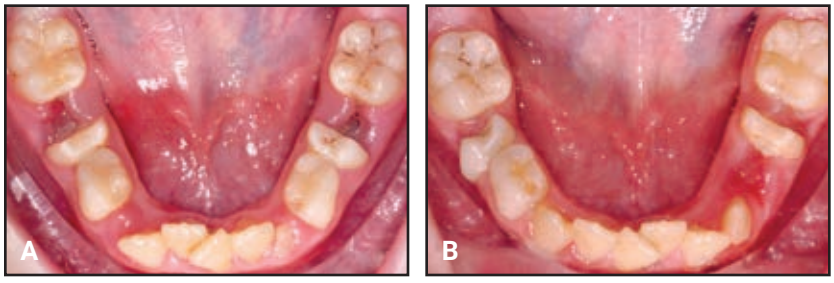

Fig. 4 Case 1. A. Distal halves of deciduous-molar crowns and roots hemisected and removed. B. Mesial drift of first molars after six more months.

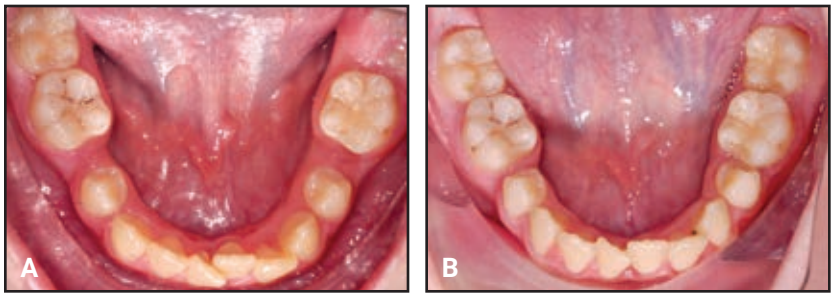

Fig. 5 Case 1. A. Mesial halves of deciduous molars extracted. B. Mesial drift of first molars after nine more months.

Fig. 6 Case 1. Patient after 15 months of treatment.

(Fig. 6). Bodily mesial movement of the first permanent molars into the spaces previously occupied by the second deciduous molars could be seen radiographically. Even though the patient was not a good candidate for controlled slicing, she was successfully treated with this method because of the lack of other options.

Case 2

A 9-year-old female presented with Class I molar relationships, mild lower anterior crowding, and a normodivergent facial profile (Fig. 7). Radiographs confirmed a congenitally missing lower right second premolar. This patient was considered an ideal candidate for controlled slicing followed by spontaneous mesial migration of the lower right first permanent molar.

Following the previously described technique, the distal half of the lower right deciduous molar was removed (Fig. 8). The first permanent molar migrated into the deciduous-molar space over 16 months.

Once the teeth approximated each other, the mesial portion of the deciduous molar was removed (Fig. 9A). The first molar completely translated into the remaining space in another 20 months (Fig. 9B). During this three-year treatment period, the lower-incisor crowding was spontaneously alleviated. When the deciduous-molar spaces were completely closed, however, there was a slight mismatch of the upper and lower midlines. SPEED System** .022" × .028" fixed

**Trademark of Strite Industries Ltd., Cambridge, ON, Canada; www.speedsystem.com.

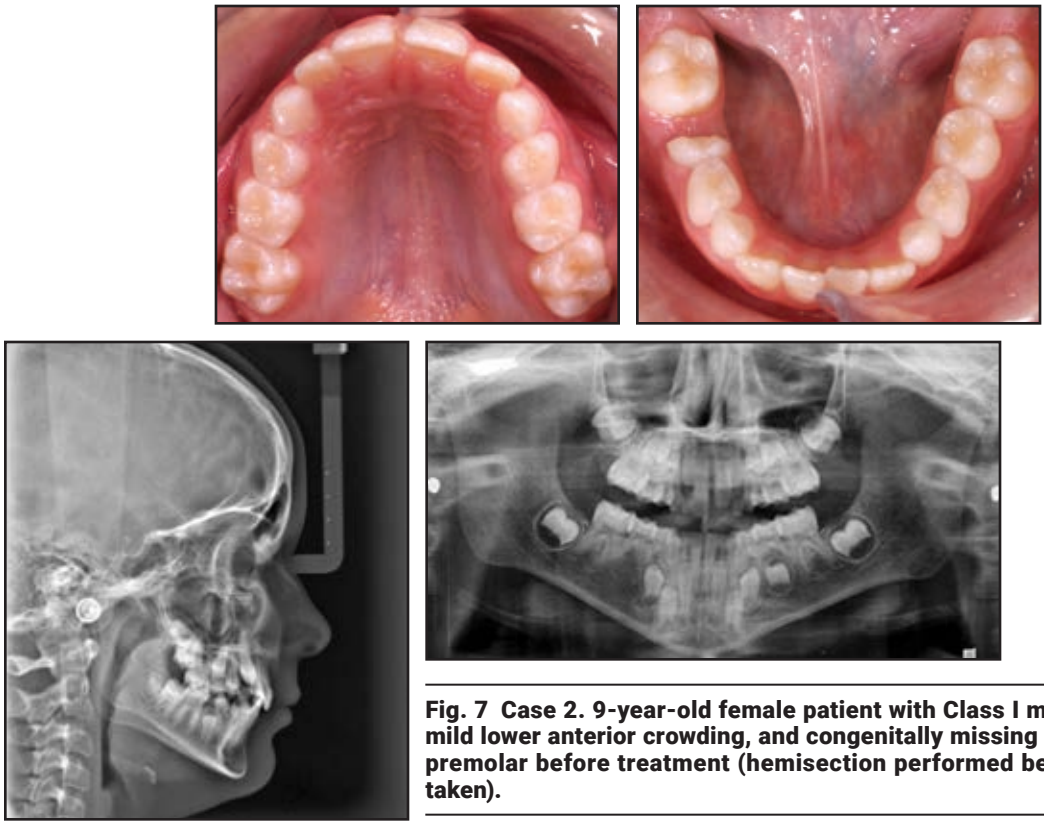

Fig. 7 Case 2. 9-year-old female patient with Class I molar relationships, mild lower anterior crowding, and congenitally missing lower right second premolar before treatment (hemisection performed before records were taken).

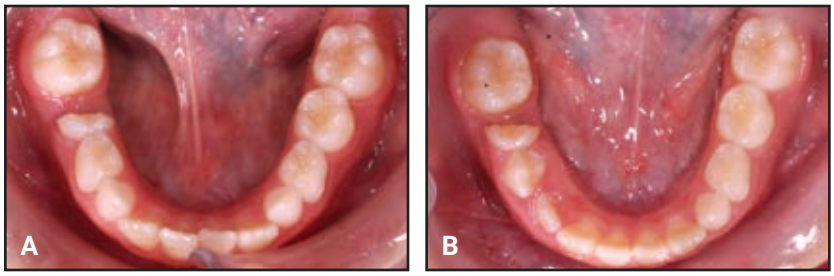

Fig. 8 Case 2. A. Distal half of lower second deciduous-molar crown and root hemisected and removed. B. Mesial drift of first permanent molar 16 months later.

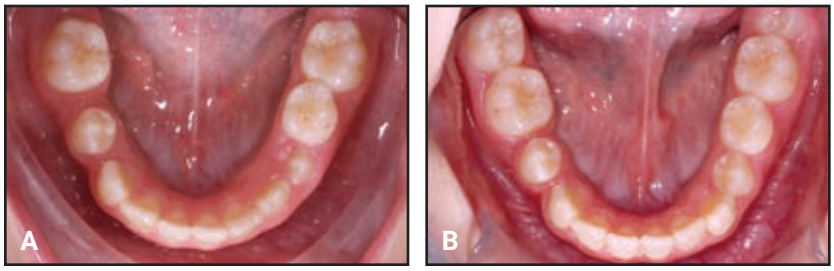

Fig. 9 Case 2. A. Mesial half of deciduous molar extracted. B. 20 months later, molar completely translated into created space.

Fig. 10 Case 2. A. .022" × .028" SPEED System appliances bonded for one year to close remaining space and correct midline discrepancy.**

appliances were placed for about one year to resolve this issue (Fig. 10).

Total treatment time was four years (Fig. 11). Controlled slicing enabled us to bypass a phase of molar protraction, which would have risked shifting of the lower midline toward the extraction site, lingual tipping of the lower incisors, and, most important, flattening of the facial profile. Progressive radiographs confirmed bodily movement of the permanent molar into the residual space. At the

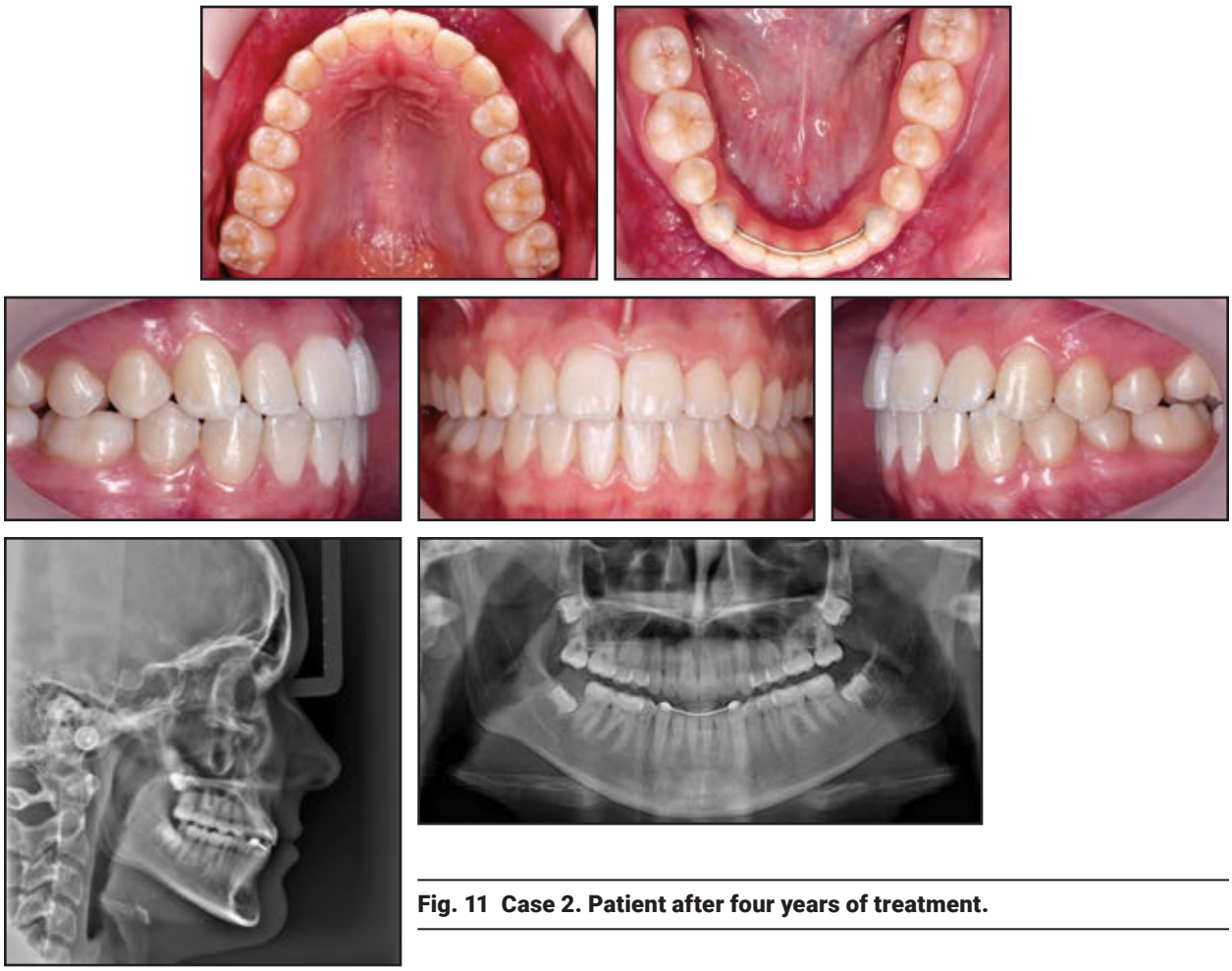

Fig. 11 Case 2. Patient after four years of treatment.

end of treatment, the patient displayed a pleasant profile, an esthetic smile, and a well-seated occlusion. A 3-3 lower lingual wire made of .032" round Remanium*** (hard) stainless steel was bonded for retention.

Case 3

An 11-year-old female presented with severe crowding and buccally ectopic canines in the maxillary arch (Fig. 12). The canines and molars were in a Class II relationship, and the patient had congenitally missing lower second premolars and infra-occluded second deciduous molars.

A two-phase comprehensive orthodontic therapy was planned. First, the controlled-slicing technique was implemented to allow spontaneous mesial migration of the first permanent molars (Fig. 13). After 12 months, about 2mm of residual space remained distal to the first premolars.

The second phase involved 12 months of .022" × .028" SPEED System fixed appliances to close spaces and correct dental irregularities (Fig. 14). The .019" × .025" stainless steel archwire was

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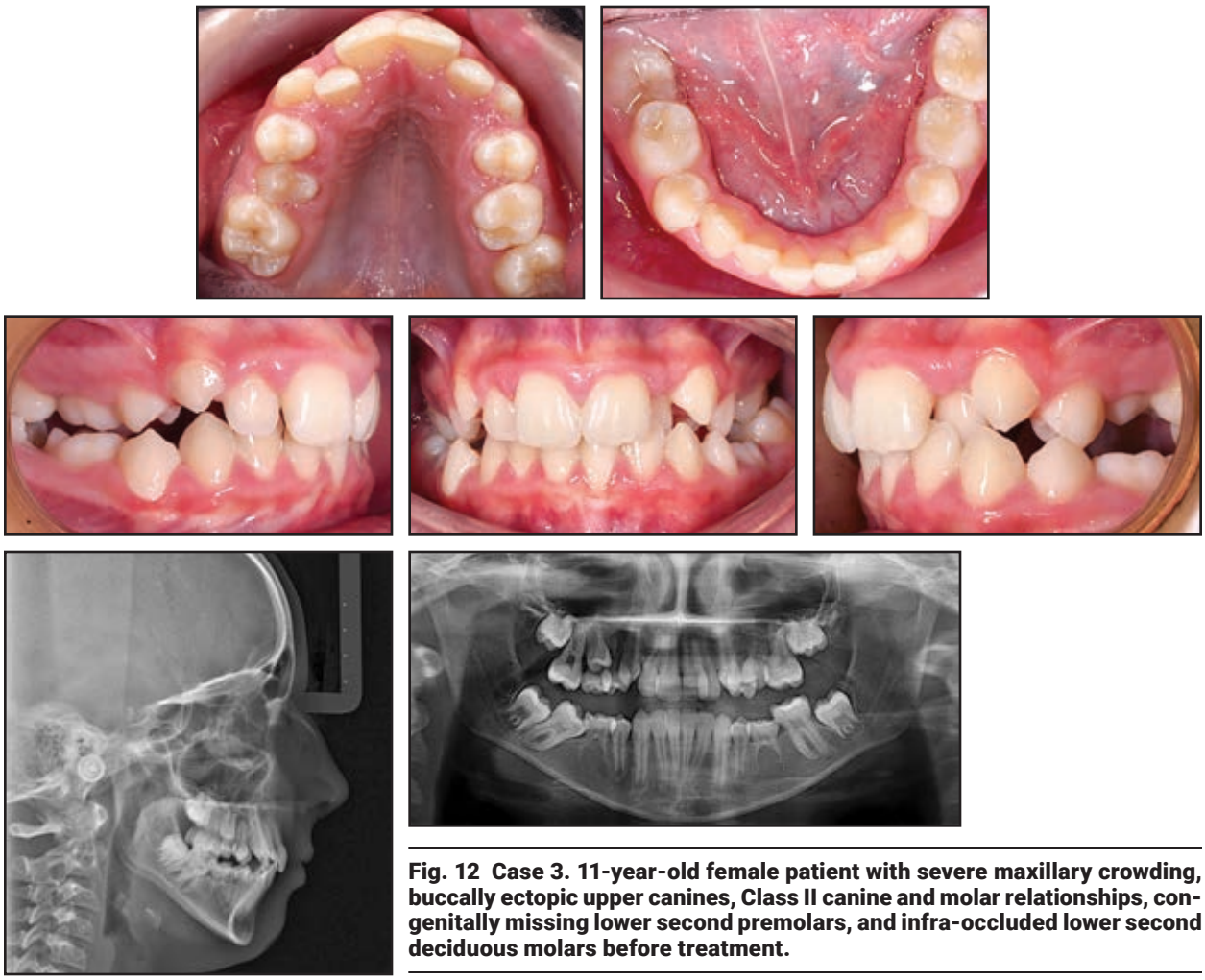

Fig. 12 Case 3. 11-year-old female patient with severe maxillary crowding, buccally ectopic upper canines, Class II canine and molar relationships, congenitally missing lower second premolars, and infra-occluded lower second deciduous molars before treatment.

Fig. 13 Case 3. Distal halves of lower second deciduous-molar crowns and roots hemisected and removed.

reduced to .017" in height by electropolishing. Hooks were inserted in the lower first-molar double tubes to enable application of the mesializing force closer to the center of resistance.

The controlled-slicing technique avoided the side effects that could have resulted from molar protraction with fixed appliances (Fig. 15). Radiographs confirmed good root parallelism, which would be crucial to ensure long-term stability in this case. A 3-3 lower lingual Remanium wire was bonded for retention.

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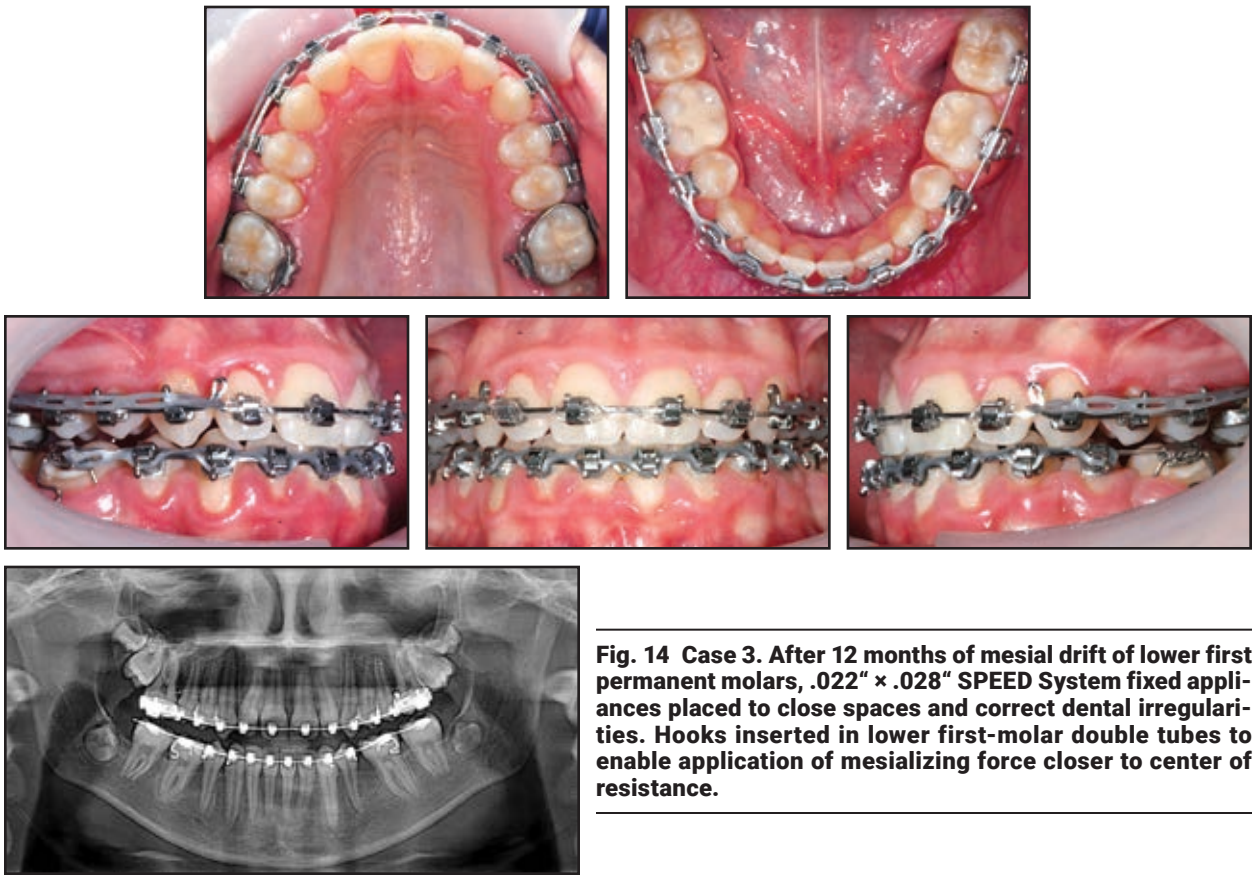

Fig. 14 Case 3. After 12 months of mesial drift of lower first permanent molars, .022" × .028" SPEED System fixed appliances placed to close spaces and correct dental irregularities. Hooks inserted in lower first-molar double tubes to enable application of mesializing force closer to center of resistance.

Discussion

Robertson and Mohlin found that most patients with congenitally missing premolars preferred space closure over prosthetic replacement.[21] If the space is to be closed orthodontically, however, the clinician must avoid any detrimental alterations to the occlusion and the facial profile. These commonly include shifting of the midline, mesial inclination of the adjacent first permanent molars, and lingual tipping of the lower incisors, all of which make it difficult to finish the case with an ideal occlusion. In addition, orthodontic molar protraction requires lower anterior anchorage reinforcement from methods such as fixed functional appliances, protraction headgear, or Twin Blocks.*[22] Such techniques depend on patient compliance and, if left unmonitored, risk a reduction of the residual alveolar ridge, both buccolingually and occlusogingivally. Miniscrews have also been used to anchor molar protraction,[23] but they can damage anatomical structures and often cause soft-tissue inflammation.

The controlled-slicing technique represents a unique option for bodily mesial movement of the first permanent molars without complex biomechanics. A 90% success rate has been reported when the technique is applied between ages 8 and 9.[5] This method helps to preserve the buccolingual bone plate, which is maintained by the residual mesial portion of the deciduous molar after hemisection, thus avoiding any undesirable mesial rotation.

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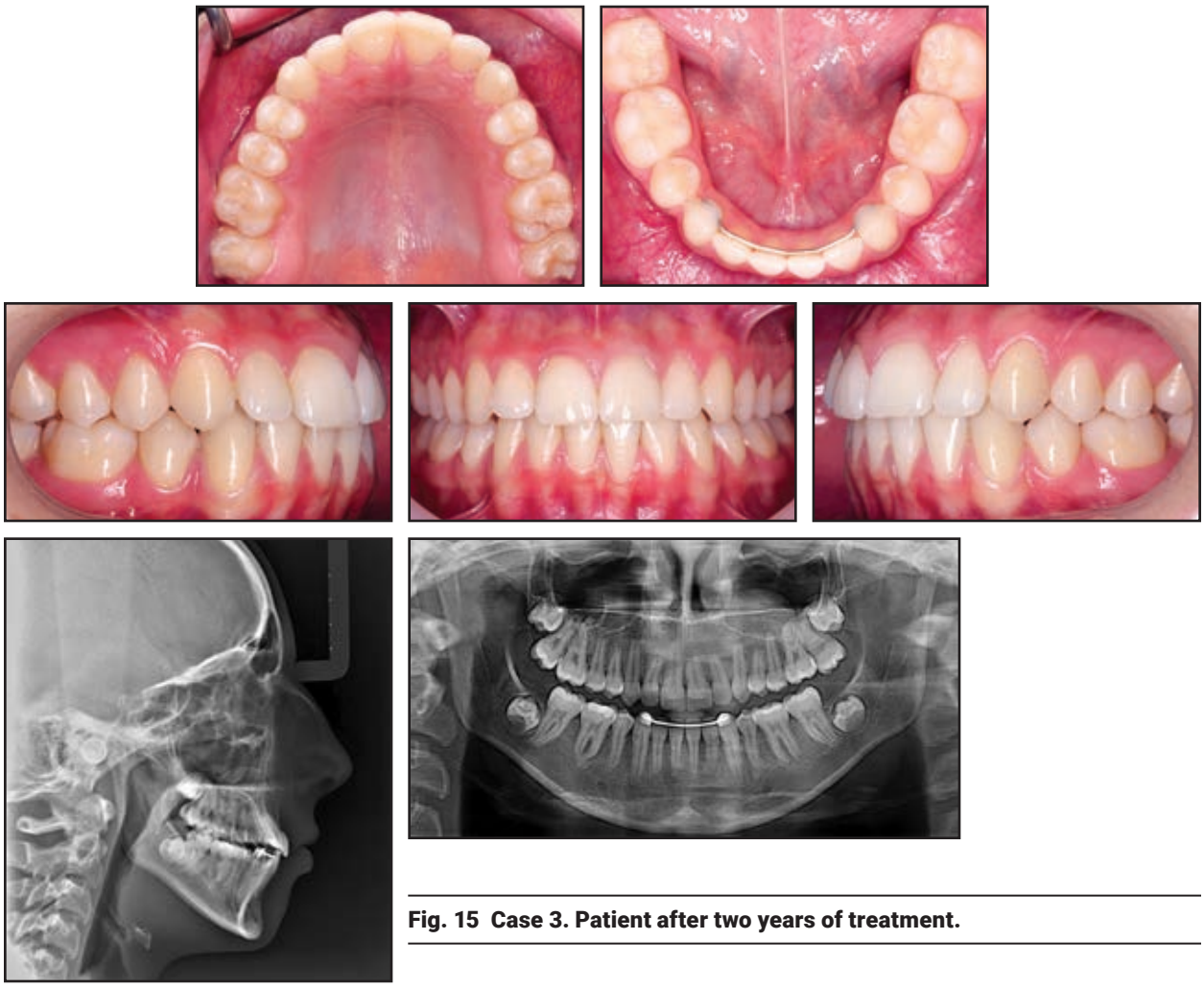

Fig. 15 Case 3. Patient after two years of treatment.

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